

Two new *Taifanglania* species identified through DELTA-assisted phenetic analysis

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Abstract — Two new species isolated from soil samples from Mianyang City, Sichuan Province and Nantong City, Jiangsu Province, China, were revealed through classical morphology and DELTA-assisted analyses. Both species are described and illustrated and diagnostic characters revealed through DELTA are discussed. *Taifanglania berberidis* is characterized by brown colony, black reverse, phialides $7.2\text{--}13.5 \times 1.8\text{--}4.2\text{ }\mu\text{m}$, with an ellipsoidal swollen basal portion and fusiform conidia, $4.8\text{--}9.0 \times 1.8\text{--}3.0\text{ }\mu\text{m}$; *T. jiangsuensis* is distinguished by yellow colony, rough or smooth-walled hyphae, phialides $6\text{--}15 \times 1.8\text{--}3.0\text{ }\mu\text{m}$, with a cylindrical swollen basal portion and ellipsoidal or fusiform conidia, $3.6\text{--}6 \times 2.4\text{--}3.0\text{ }\mu\text{m}$, forming chains and often capitate at the top.

Key words — thermotolerant fungi, morphological character, numerical classification

Introduction

The genus *Taifanglania* was established by Liang et al. (2009), who selected *T. hechuanensis* as the type species and accepted nine species in the genus worldwide. *Taifanglania* species are thermophilic fungi that play an important role in cellulose degradation of compost, garbage, and straw (Liang et al. 2007; Kluczek-Turpeinen et al. 2003, 2007; Kluczek-Turpeinen 2007). In addition, they can produce novel active substances (Hill & Pitt 1999) and useful thermophilic enzymes such as laccases (Liang et al. 2007, 2009; Yang et al. 2006).

The recent use of molecular data in systematic analyses has enabled the identification of many new fungi (Luangsa-ard et al. 2004, 2005; Rehner & Buckley 2005; Sung et al. 2007). However, as noted by Hawksworth (2004), only about 11.5% of the known species were represented among the fungal sequences present in Genbank in 2004 and of those, regrettably approximately one-fifth was incorrectly identified. In addition, Paterson (2007, 2008) has

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reported that mycotoxins present in some cultures may adversely affect DNA sequence analysis. For these reasons, many researchers use polyphasic taxonomy based on molecular, morphological, numerical approaches and physiological data (Houbraken et al. 2007; Samson et al. 2007; Varga et al. 2007a,b). In this regard, the DELTA expert morphology-based system offers many advantages to the classical taxonomic research of animal, plant and microbes that permit digital standardization of morphological characters to make them suitable for taxonomic identification (Carney 2003; Chang et al. 2000; Chen & Chen 2008; Li et al. 1993; Li 1996) and international communication (Chen & Kuoh 2000a,b; Han et al. 2009). In this paper we report and illustrate two new *Taifanglania* species, *T. berberidis* and *T. jiangsuensis*, that were identified using classical morphology in the DELTA system.

Materials and methods

MATERIALS—The eleven *Taifanglania* species used in the study are listed in TABLE 1.

SAMPLE COLLECTION AND STRAIN ISOLATION — Strain GZUIFR-SGQH346 and GZUIFR-HC48.1 were isolated from soil samples of Mianyang City, Sichuan Province and Nantong City, Jiangsu Province, China, respectively. Two grams of soil were added to a flask containing 20 ml sterilized water and glass beads. Each soil suspension was shaken for about 10 min. and then diluted to concentrations of 10⁻¹–10⁻². One ml suspension (10⁻²) was mixed with Martin medium in a sterilized Petri dish of 9 cm diam. Cultures were incubated at 40°C for 14 days.

STRAIN IDENTIFICATION — The strains were transferred to Czapek agar. After incubation at 40°C for 7 days, the strains were identified based on colony characters and conidiogenous structures according to Liang et al. (2009).

TABLE 1. List of *Taifanglania* spp. for constructing DELTA database

No.	NAMES	REFERENCES
1	<i>T. ampullaris</i> (Matsush.) Z.Q. Liang et al.	Matsushima 1971, Liang 2009
2	<i>T. ampulliphora</i> (Matsush.) Z.Q. Liang et al.	Matsushima 1975, Liang et al. 2009
3	<i>T. biformis</i> (Z.Q. Liang et al.) Z.Q. Liang et al.	Liang et al. 2007, 2009
4	<i>T. cinerea</i> (Z.Q. Liang et al.) Z.Q. Liang et al.	Liang et al. 2006, 2009
5	<i>T. curticatenata</i> (Z.Q. Liang & Y.F. Han) Z.Q. Liang et al.	Han et al. 2007, Liang et al. 2009
6	<i>T. furcata</i> (Z.Q. Liang et al.) Z.Q. Liang et al.	Liang et al. 2006, 2009
7	<i>T. hechuanensis</i> Z.Q. Liang et al.	Liang et al. 2002, 2009
8	<i>T. inflata</i> (Burnside) Z.Q. Liang et al.	Samson 1974, Liang et al. 2009
9	<i>T. major</i> (Z.Q. Liang et al.) Z.Q. Liang et al.	Chu et al. 2004, Liang et al. 2009
10	<i>T. berberidis</i>	(this work)
11	<i>T. jiangsuensis</i>	(this work)

TABLE 2. Characters and character states in *Taifanglania*

#1. Note/	#10. Phialides length/ μm /
#2. Colony/	#11. Phialides width/ μm /
#3. Colony color/ 1. Pale yellow/ 2. Pale-brown/ 3. Gray/ 4. White/ 5. Yellow/	#12. Phialides <shape>/ 1. cylindric/ 2. ovoid/ 3. ellipsoid/ 4. subglobose/ 5. fusiform/
#4. Reverse color/ 1. Yellow/ 2. Dark/ 3. Offwhite/	#13. Conidia surface/ 1. tiny rough/ 2. smooth/
#5. Colony texture/ 1. Compact velvety/ 2. Velvety, powdery or floccose to funiculose/ 3. Short floccose/ 4. Loose velvety/	#14. Conidia <shape>/ 1. ellipsoid/ 2. subglobose/ 3. cylindric/ 4. ovate/ 5. obovoid/ 6. fusiform/ 7. Lemon-shaped/
#6. Vegetative hyphae <width μm >/	#15. Conidia width/ μm /
#7. Hyphae surface/ 1. tiny rough/ 2. smooth/	#16. Conidia length/ μm /
#8. Conidiophore/ 1. present (simple) 2. lacking/	#17. Conidial chain/ 1. long/ 2. short/
#9. Phialides/	#18. Inhabit/ soil/

THE PHENETIC TREE GENERATED BY DELTA SYSTEM —Diagnostic characters and character states from the selected *Taifanglania* strains were entered into DELTA system as described by Han et al. (2009) to form the database (TABLE 2). According to the program CONFOR with the “todis” directives of Editor, the phenetic tree was generated by DELTA system using the PCLASS program.

New species

Taifanglania berberidis Y.F. Han & Z.Q. Liang, sp. nov. FIG. 1
MYCOBANK MB 516503

In agaro Czapekii, coloniae 75–80 mm diam., 14 diebus ad 40°C, planae, brunnea. *Conidiophora* absentia. *Phialides* singulares, 7.2–13.5 × 1.8–4.2 μm , e basi inflata ellipsoidea in collum distinctum apice inspissato angustatae. *Conidia* fusiformia, 4.8–9.0 × 1.8–3.0 μm , catenata, interdum et capitata ad extremam.

Holotypus GZUIFR-SGQH346 isolatus, e soli, Mianyang City, Provincia Sichuan, China. VIII, 2006, Y.F.HAN, in Guizhou Univ, conservatur.

ETYMOLOGY: *berberidis* (Latin), referring to the associated plant genus.

COLONY on Czapek agar reaching 75–80 mm diam. within 14 days at 40°C, flat, felty, with brown center and gray margin, irregularly radially grooved, faintly wavy at the margin. Reverse black. VEGETATIVE HYPHAE hyaline, smooth-walled, 1.2–3.0 μm in diam. PHIALIDES single, borne directly on the vegetative hyphae, 7.2–13.5 $\times$ 1.8–4.2 μm , with an ellipsoidal swollen basal portion, tapering into a distinct neck. CONIDIA hyaline, smooth-walled, fusiform, 4.8–9.0 $\times$ 1.8–3.0 μm , forming chains and sometimes capitate at the top.

DISTRIBUTION: Sichuan Province, China.

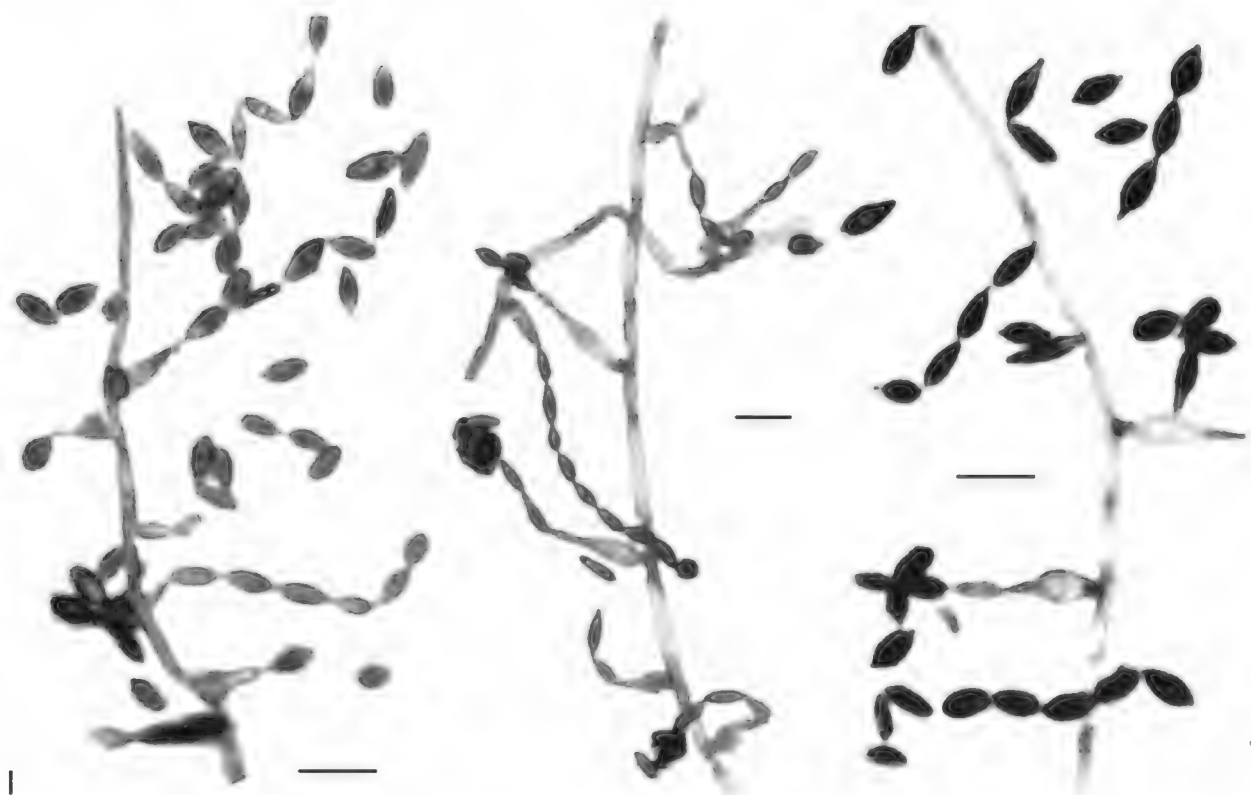


FIG. 1. Conidiogenous structures of *Taifanglania berberidis*. Bars = 10 μm

COMMENTS: Other *Taifanglania* species characterized by fusiform conidia are *T. inflata*, *T. jiangsuensis*, *T. hechuanensis*, and *T. biformis*. The following characters separate those species from *T. berberidis*: *T. inflata* is mesophilic, *T. jiangsuensis* colonies are yellow, the reverse of *T. hechuanensis* colonies is gray, and *T. biformis* has an echinate conidiophore. *Taifanglania berberidis* can be distinguished by its thermophilic character, brown colony with the black reverse, single phialides, and often capitate top of conidial chain.

***Taifanglania jiangsuensis* Y.F. Han & Z.Q. Liang, sp. nov.**

FIG. 2

MYCOBANK MB 516504

In agaro Czapekii, coloniae 45–50 mm diam., 14 diebus ad 40°C, villiformis, flava. Conidiophora absentia. Phialides singulares, 6–15 $\times$ 1.8–3.0 μm , e basi inflata cylindrica in collum distinctum apice inspissato angustatae. Conidia ellipsoidea vel fusiformia, 3.6–6 $\times$ 2.4–3.0 μm , catenata, saepea et capitata ad extremam.

Holotypus GZUIFR-HC48.1 isolatus, *e soli*, Nantong City, Provincia Jiangsu, China. IV, 2005, Y.F.HAN, in Guizhou Univ, conservatur.

ETYMOLOGY: *jiangsuensis* (Latin), referring to Jiangsu Province, where the type locality is situated.

COLONY on Czapek agar reaching 45–50 mm diam. within 14 days at 40°C, villiform, light yellow. Reverse yellow. VEGETATIVE HYPHAE hyaline, rough or smooth-walled, 0.6–1.2 μm diam. PHIALIDES single, sometimes proliferating, borne directly on the vegetative hyphae, 6–15 $\times$ 1.8–3.0 μm , with a cylindrical swollen basal portion, tapering into a distinct neck. CONIDIA hyaline, smooth-walled, ellipsoidal or fusiform, 3.6–6 $\times$ 2.4–3.0 μm , forming chains, often capitate at the top.

DISTRIBUTION: Jiangsu Province, China.

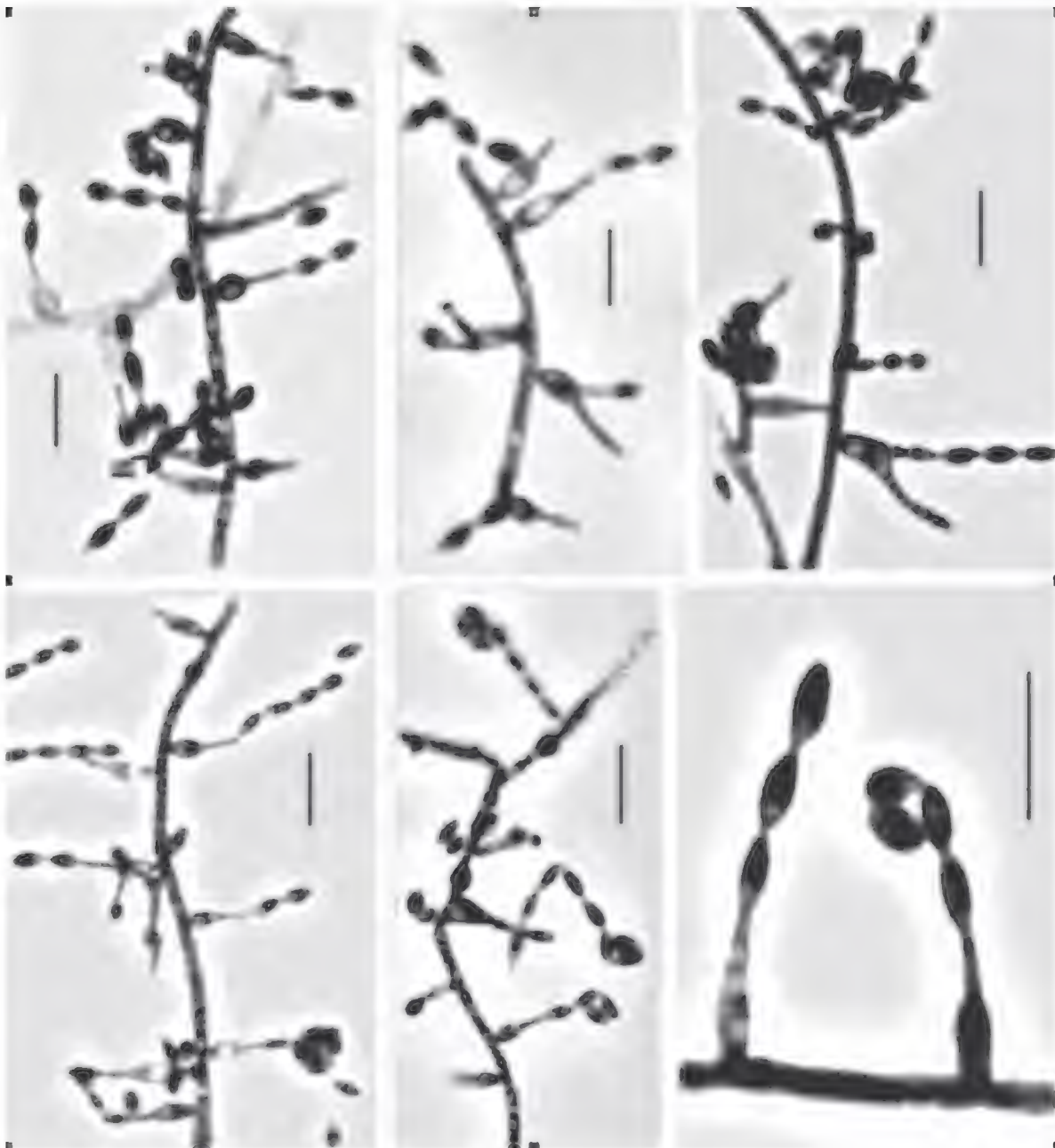


FIG. 2. Conidiogenous structures of *Taifanglania jiangsuensis*. Bars = 10 μm

COMMENTS: Other *Taifanglania* species that produce light colonies on Czapek agar are *T. inflata* and *T. ampullaris*. *T. jiangsuensis*. The fact that *T. inflata* is mesophilic and *T. ampullaris* produces smaller conidia ($2.2\text{--}3.4 \times 2\text{--}2.6 \mu\text{m}$) differentiate those species from *T. jiangsuensis*. Additionally *T. jiangsuensis* may possess either smooth or rough hyphae.

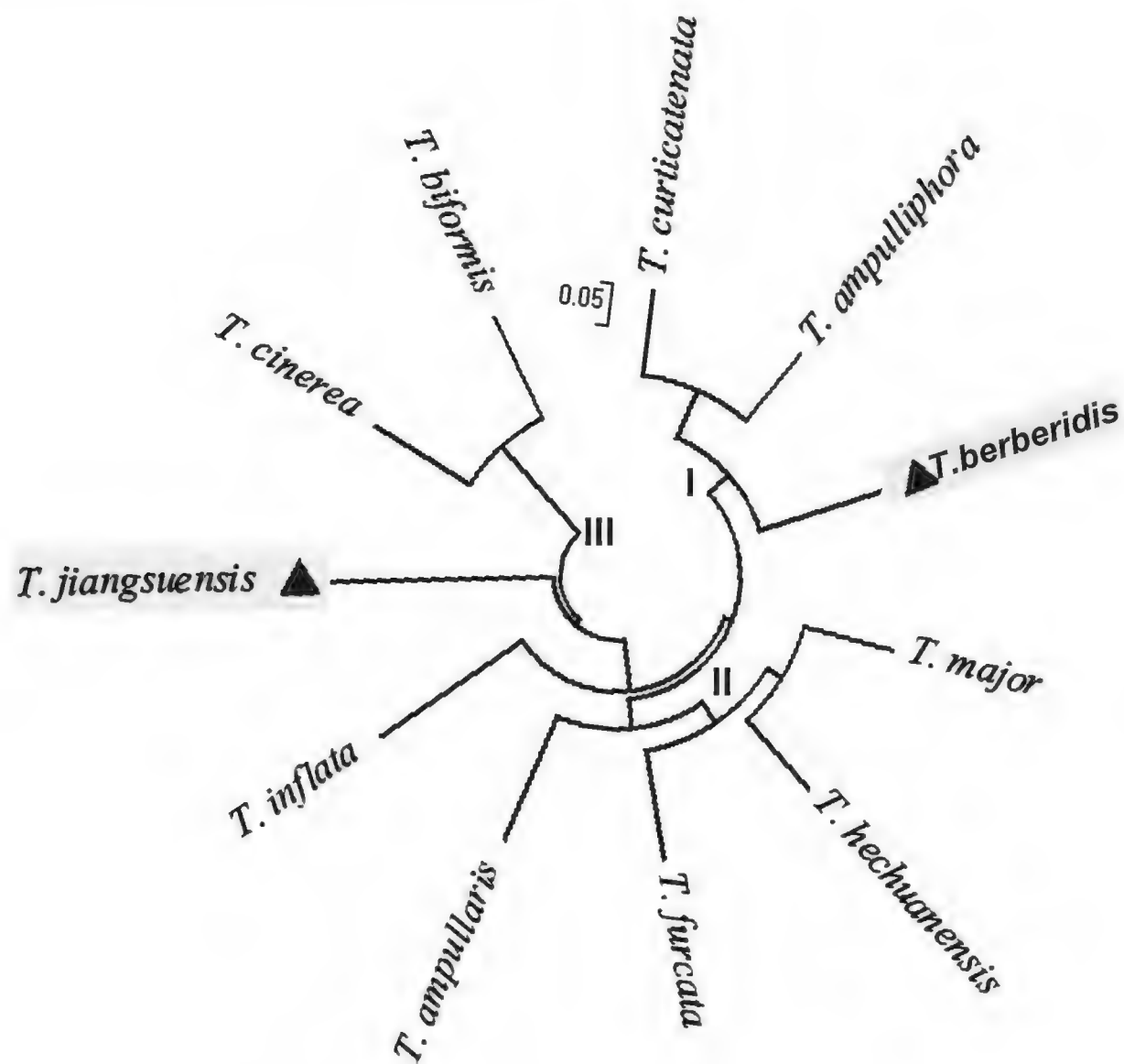


FIG. 3. Phenetic tree generated for *Taifanglania* spp. by DELTA.

Numerical taxonomy

Numerical character classification was not granted special priority, so that all characters selected were weighted equally in this study. The phenetic tree based on the morphological characteristics is presented in FIGURE 3, which separates *T. jiangsuensis* and *T. inflata* from each other and from all other *Taifanglania* species. The remaining species fall into three distinct groups (I–III).

Group I species (i.e., *T. curticatenata*, *T. ampulliphora*, *T. berberidis*) all produce brown colonies on Czapek agar. Both *T. curticatenata* and *T.*

ampulliphora are characterized by rough conidia (Han et al. 2007, Matushima 1975), separating them from *T. berberidis*, which produces smooth, fusiform conidia, which supports *T. berberidis* as an independent species.

Group II species (i.e., *T. major*, *T. hechuanensis*, *T. furcata*, *T. ampullaris*) share light colony color and phialides with ellipsoidal basal portions.

Group III includes *T. cinerea* and *T. biformis*, whose common characters are the villiform colony and conidia that are fusiform, ellipsoidal to cylindrical, and longer than 13 μm . Within the group, the unique biform conidiogenous structures separate *T. biformis* from *T. cinerea* (Liang et al. 2006, 2007).

The new species *T. jiangsuensis*, which stands on an independent branch, can be characterized by its yellow villiform colony, yellow reverse, and tiny rough hyphae.

The phenetic tree generated from morphological characters observed in the eleven *Taifanglania* species using the INTKEY program of DELTA system showed that colony color, colony texture, shape of conidia, reverse color, and conidial length are diagnostic for the identification of *Taifanglania* species.

In conclusion, *T. berberidis* and *T. jiangsuensis* are two new distinctive taxa with the support derived from morphology with the phenetic analysis of DELTA system.

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